DOCUMENT RESUME

ED 154 834 IR 006 004

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TITLE A Review of Computer Assisted Instruction Activities at the University of Akron.
PUB DATE 2 May 75
NOTE 12p.; Paper presented at the Ohio Chapter of the Mathematical Association of America (Bowling Green, Ohio, May 2, 1975); For related document, see IR 006 005

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS College Faculty; Communication Problems; *Computer Assisted Instruction; Facilities; *Higher Education; Instructional Design; *Mathematics Education; Programed Instruction

ABSTRACT

This review of the facilities and programs that are devoted to computerized instruction at the University of Akron provides brief descriptions of the history of the Computer Assisted Instruction Center, the development of a CAI course in mathematics, directions for future development, and problems in communication between mathematics instructors and computer oriented support people. (BBM)

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ED154834

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A REVIEW OF COMPUTER ASSISTED INSTRUCTION ACTIVITIES AT THE UNIVERSITY OF AKRON

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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND USERS OF THE ERIC SYSTEM."

IR006004

Distributed at The Ohio Chapter of The Mathematical Association of America, Bowling Green University, Bowling Green, Ohio, May 2, 1975.

INTRODUCTION

Computer Assisted Instruction, in the past few years, has exploded like a plethora of meteorites across the education horizon. However, unlike the fast fading meteorites this phenomena seems to increase in its brightness as time goes on. Not since the days of the early printing press has education been provided with such a major breakthrough. We now have available on an around the clock and an around the globe basis, a facility that has a responsiveness and patience that can not be matched in human form. It is by no means the complete teacher but it is an instructional tool that can do much to help human teachers become more complete teachers to the students they serve. It does this by developing basic skill abilities within individual students by means of direct detection of needs and direction to means that enable students to develop the basic tools needed for higher learning. In short it helps students to become more complete learners.

What follows in this paper is a review of the facilities and programs that are devoted to computerized instruction at The University of Akron.

COMPUTER-ASSISTED PROBLEM SOLVING

There are two support groups currently devoted to the use of the computer for instruction at this university. The first group

is part of the computer center personnel. This group has the responsibility of operating the computer system, as well as maintaining and supporting the software and hardware of the academic computer systems of the entire university. In addition to these responsibilities this group as part of its strategy for supporting instructional activities has disbursed a number of Anderson-Jacobsen (A-J) typewriter terminals throughout the university campus. These A-J terminals are presently used primarily as vehicles to utilize A Programming Language (APL). APL is a mathematical computer language which enables faculty and students to gain access to a number of purchased canned programs that will operate on statistical and numerical integration problems. This has provided several instructors with the opportunity to develop simple APL programs that serve as an aid to problem-solving activities associated with the teaching-learning process in their courses.

COMPUTER ASSISTED INSTRUCTION

The second support group is specifically called The Computer Assisted Instruction Center and Dr. John Hirschbuhl is its director. The Computer Assisted Instruction Center consists of a large room in which there are twelve IBM 3270 Cathode Ray Tube terminals, two Anderson-Jacobsen typewriter terminals and one Magnovox plasma terminal. With the exception of the plasma type terminal all terminals in the center are supported by the University's IBM 370:158 computer located in the computer center in Simmons Hall at the

University of Akron. The plasma type terminal is supported by The University of Illinoes Plato IV system in Urbana Illinois.

The IBM 3270 terminals are dedicated to the Computer Assisted Instruction (CAI) language, Coursewriter III. The Magnovox plasma display terminal is dedicated to the University of Illinois TUTOR language. The Anderson Jacobsen typewriter terminals are able to be addressed by both Coursewriter III and the York APL languages. It is important to note that although the A.J. terminals are capable of delivering CAI in its total form, these terminals are used primarily for the purpose of producing hard copy reports for faculty who have students using the system. The Magnovox plasma display terminal is a recent addition on which we are exploring an instructional system which makes extensive use of graphics. Obviously, this has implications for mathematics and all the sciences-including medicine.

PEOPLE SUPPORT

The University of Akron system provides support for courses of instruction in Chemistry, English, Education, Engineering, and Mathematics, that are used on a daily basis by the faculty and students of the University. The facilities used for these applications are housed in the mezzazine area on the second floor of Carroll Hall, which is located at the geographic center of the University. In addition to the hardware and courseware, there is a support staff that is continually on hand to assist faculyt and students while they

use the system.

Faculty are helped with the building of instructional materials and the logistics of handling students in the terminal area. Students entering this room are registered by student monitors. Such tasks as registering students for courses, helping users with problems at the terminals, providing weekly detailed reports on student progress and assisting faculty authors are all performed by the CAI staff. These student monitors represent many academic disciplines and are able to program, operate, and maintain the terminals. In fact these students can and do provide almost all of the on going assistance that is needed by the ordinary faculty and student user.

THE PEOPLE WHO ARE SERVED

To-date the University of Akron CAI Center has provided instructional assistance to well over 20,000 students. These students are located at several locations. In the past and at present students are being served at locations such as Kent State University (6 terminals), Villanova University (1 terminal) Foxvalley Technical College of Wisconsin (1 terminal) and Woodridge Junior High School in Peninsula, Ohio (1 terminal).

ATTRACTING ATTENTION

Such widespread use has attracted the attention of several ed-

ucators and computer vendors. At present time we are one of the two institutions in the United States which are piloting the use of IBM's forthcoming new version of Coursewriter and other vendors of CAI such as Hewlett Packard, Digital and Control Data Corporation have expressed interest in our center for the purpose of piloting their support systems for our CAI activities. In addition to this we are engaged in a joint effort with the University of Waterloo of Ontario, Canada. Hopefully this effort will provide a method of blending the full capabilities of the television camera with the computers storage and retrieval capabilities so that real-time, full color, random-access T.V. facilities will be made possible.

HOW DID IT HAPPEN?

Interest in such an undertaking came about as a result of several years of gradual build up to the present situation. To-date there have been three summer workshops in which over 150 participants have shared in the development of this systematic attempt to provide a cost effective means of truly individualizing instruction. In addition there have been 14 classes at the graduate and undergraduate level in which over 200 students have participated in learning and developing methods of creating and delivering computerized instruction.

All of this activity had its beginning during the summer of 1972 when Lawrence Stolurow and a few dedicated pioneers came to

the University of Akron and with their help CAI came to the University with the first summer workshop on CAI. At that time the future of this system did not look bright but the impetus of that effort brought terminals to the campus and the beginnings of courses that focused on the techniques involved in the development of CAI. During the next summer (1973) Pat Suppes and other veterans of CAI development kicked off The University of Akron CAI workshop. Our present facilities were viewed by a very successful nationally attended summer workshop. From that point on development has been steady and rapid and at the present time we are able to offer 87 CAI courses as part of our facility.

What follows is a brief history of that development and mention of one professor who played a key role in that development.

THE BIRTH AND GROWTH OF A CAI COURSE

During the Spring Quarter of 1973,work was begun on the first computerized instruction application at the University of Akron. Dr. Peter Gingo and Dr. John J. Hirschbuhl began the development of a set of instructional episodes that would effectively teach the concepts of Absolute Values and Inequalities in the Real number system. The course provided diagnosis and treatment by means of dynamic non-linear drill exercises on linear inequalities of the form $A X + B(\leq, \not<) C$, and an exhaustive set of operations with absolute values.

The focus of this computerized instruction was on operations

in the real field and their effects on inequalities. In addition to this idea the distance from a point concept was used to develop and illistrate the concept of absolute value. The instructional mondules and an accompaning question bank were first developed for delivery by means of an IBM 2741 typewriter terminal. Later, during the Fall of 1974 these same materials were revised and updated so that they could be effectively delivered by means of IBM's 3270 Cathode-Ray Tubes. Modules were programmed in the language known as coursewriter III and stored in the IBM 370:155 operating system. The language used was an instructional programming language developed by IBM which has excellent instructional and record keeping capabilities. For example we were able to determine just what questions a student had problems with and we were able to pinpoint those areas of instruction which had not met the task of teaching the assigned material at a predefined criteria rate. All of the programming capability needed to do this assessment was within the coursewriter system. In addition to these convenient content and item analysis capabilities, it was also possible to randomly select questions from the question banks so that students received different but equivalent tests on the material they had studied. For example in the course INEQ (Absolute Values and Inequalities) there was placed a set of 600 questions from which 30 were drawn for each instructional module. These questions were stored and classified by objective and each set of objectives was tested by randomly selected items. This CAI program also provided the instructor with such information as:

1. How long the student has worked at the terminal
2. When he first worked at the terminal
3. When he last worked at the terminal
4. What was the last objective he worked on
5. What was achievement rate to date
6. A summary of his achievements on each completed objective

Such facilities have made INEQ a popular course with both faculty and students. Students liked the feedback they got as they proceeded through the instructional objectives and were conscious of the fact that the instruction was being tailored to their needs based on their performance, at a rate that was determined by them, and at times that were of their choosing.

WHAT IS THE MAIN INGREDIENT?

Such capabilities had a price. That price was hard work. Dr. Peter Gingo had to specify in operational terms each and every objective that he wanted taught. He had to provide test items to test and teach each objective and he had to specify what the minimum acceptable criteria would be for student performance on each objective. Furthermore he had to provide alternative means of instruction for each objective and these had to be sorted on the basis of student past performance.

The results of this effort was a well planned, well designed, effective instructional system. At least 85% of the students who took this course mastered the concepts that it attempted to teach.

When considering what had been the usual performance levels of students in our pre-calculus courses on these topics the results were most encouraging.

WHERE ARE WE GOING?

Since the building of this first course several others have been built or imported from outside sources. We established courses on Set Notation and Operations from East Texas State University, a freshman Modern University Mathematics Course and Retest developed by William Hockman and Thomas Warner of the University of Akron; Basic Mathematics Concepts developed by the Kansas City School District, Kansas City, MO.; Directed Numbers developed by Thomas Obedier of the University of Akron; a Statistics course developed by Timothy Taylor (University of Akron) and a new emerging course on fractions,decimals, and percentage developed by Dr. John J. Hirschbuhl and Thomas Oberdier incorporating some very innovative uses of graphics and review techniques to insure lasting performance on all instructional objectives.

BRIDGING THE COMMUNICATIONS GAP

One of the problems with acceptance of such instructional systems is the difficulty in communications that exists between professional mathematics instructors and computer oriented support people.

It is difficult to communicate the capabilities of a non-computational computer language to the professional mathematicianl It is much easier for them to see the value of a problem solving language such as APL, BASIC or FORTRAN because these languages lend themselves well to the mathematician's way of doing things. The computer assisted problem solving that these languages are used for are excellent, but when it comes to teaching fundamentals and monitoring student performance a different type of application is needed. The Computer Assisted Instruction Center has delivered that capability to the University of Akron. In the future we are confident that mathematics educators at all levels will begin to realize and enjoy the benefits of suth an instructional language and it will become another one of the tools that the mathematics educator uses to increase and spread the skills and beauty of mathematical thought.